

THE TRANSDUCER ENVIRONMENT

The design of Knowles transducers is principally for use in hearing instrument applications and they have been extensively tested in that environment. While Knowles transducers can be used for other applications in environments comparable to those found for hearing instrument use, it is suggested that tests be carried out to confirm the suitability for a particular application. The following guidelines for use are divided into two groups:

a. Those related to the **HANDLING** of the transducer during assembly into the finished product or application to ensure that the transducer is not destroyed before use and that latent faults are not introduced that will limit the life of the transducer in the field.

b. Those related to the **APPLICATION ENVIRONMENT** in which the transducer will be used.

HANDLING

1. Knowles transducers are, by their very nature, sensitive to small forces. While they have been designed to survive large shock and vibration forces, there are limits beyond which permanent damage will occur. In use, the transducer devices must be resiliently mounted to limit these forces, and prior to installation in the mounting, care should be taken not to knock or drop units even a few centimetres.

2. **Holding Fixures** should restrain the unit without any deformation as the cases are quite thin and active elements are close to the case walls. For the same reason, no probe should be inserted into the sound port.

3. Soldering

Temperatures far in excess of those that will damage the active elements are needed for soldering leads to the units. It is therefore necessary to ensure that the heat is not transferred from the terminals to the interior of the device. Knowles Technical Bulletin TB4 gives guidelines on soldering, and the ET series Data Sheet gives details of suitable

heat sink fixtures which are available from Knowles.

4. Contaminants

It is necessary for the interior of each microphone and receiver to be open to the air in order to function. This design and function constraint allows the ingress of solid particles, liquids and vapors. In the application of Knowles transducers, care must be taken so that fine dust particles do not enter and block the movements in the very small internal gaps. (Magnetic particles could be drawn into the gaps of receivers).

Liquids, if present, could cause damage by restricting internal motion and putting undue strain on the moving elements. Liquid or gaseous solvents or corrosives could destroy the metals or adhesives used in the construction, or discharge the electret element in microphones.

For this reason, scrupulous cleanliness should be maintained during parts storage and assembly, and solvents used sparingly and only in well ventilated work areas.

Acetone, Toluene, Chlorocarbons and some RTV sealants are examples of materials to be avoided.

IF YOU ARE NOT CERTAIN THAT MATERIALS IN USE ARE "TRANSDUCER SAFE", CONTROLLED TRIALS SHOULD BE CARRIED OUT - OR CONTACT KNOWLES TECHNICAL SALES FOR ADVICE.

5. Electrostatic Discharge

Knowles electret (and piezoelectric) microphones contain a sensitive junction field effect transistor which can be damaged by high electrostatic discharges. During lead attach to the transducer and then to the user circuit, the usual precautions against electrostatic discharge should be taken. Once connected to the users circuit, the problem should not exist. In particular the work place should be grounded as should the soldering iron, and synthetic fabrics should be avoided or treated with antistatic spray.

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6. Temperature

Most of Knowles products incorporate materials which should not be subjected to temperatures in excess of 63° C (145° F). Above this temperature, irreversible damage occurs. Receivers that are driven at high output levels produce heat, and this added to the ambient temperature must not exceed 63° C. With trained soldering personnel (and proper equipment), the brief exposure to higher temperature during assembly of leads to the soldering pads should not cause damage. Damage can occur due to high temperatures caused by the heat generated during exothermic reactions, such as the curing of potting compounds or the activation of heat shrink materials.

The transducers are not damaged by temperatures down to -40° C.

7. Humidity

Avoid processes that may cause water or other vapors to condense within transducers during assembly. It is unlikely that humidity will damage transducers during processing, unless condensation occurs without the opportunity for subsequent evaporation.

8. Radiation

Nuclear or intense electromagnetic radiation (e.g. X-rays) can cause partial or total discharge of electrets with the consequent reduction or total loss of output of the microphones. Piezoelectric microphones are more resistant, but the field effect transistors can suffer degradation with exposure

9. Pressure Changes

Normal barometric pressure changes will not damage transducers, but rapid changes in pressure (explosive decompression or blasts from a compressed air nozzle) may bend or detach the drive mechanism in receivers or collapse the diaphragms in microphones.

CAUTION: Users of Knowles receivers in hearing instruments and in other products are advised that these receivers have the capacity to produce very high levels of sound pressure.

TO AVOID POSSIBLE HEARING DAMAGE, SPECIAL CARE SHOULD BE EXERCISED WHEN CARRYING OUT LISTENING TESTS ON THESE RECEIVERS.

APPLICATION ENVIRONMENT

1. Shock and Vibration

Knowles receivers are delicate mechanisms designed to give large acoustic outputs for small electrical inputs and must, therefore, respond to very small forces. The forces involved in dropping the transducer even 30 cm onto a hard surface may be as much as 10⁸ times the operating forces. Therefore the receiver must be cushioned by a suitable shock mount or the unit may become distorted or fail completely. The moving parts within the receiver and the driven air cause the receiver case to vibrate. This could result in buzzes or rattles when used with a rigid mount, and this vibration may be transmitted to other vibration sensitive elements in the equipment. For this reason, a composite shock and vibration mount should be used. Knowles Technical Reports TR1 and TR3 may help in the design of this mount for your application.

2. Contaminants

If the transducer is to be used in an environment where dust or moisture is likely to enter an unprotected receiver, suitable precautions must be taken to limit or prevent this from occurring.

Where solvent or corrosive vapors are present, suitable barriers are needed to exclude these and still allow sound to pass. This is not easily achieved and may not be achievable for some materials, resulting in significant levels of corrosion. Atmospheric sulphur can cause sudden receiver failure due to open circuit coils. One potential source of contaminant that must be avoided is undervulcanised natural or synthetic rubber used in connecting tubes or shock/vibration mounts.

3. Electrostatic Discharge

This is not normally a problem with the microphone connected to the circuit in the application. It is not a problem with receivers.

4. Temperature

Operational and Storage temperatures in the range -17°C to $+63^{\circ}\text{C}$ are acceptable. Lower non-operational temperatures have been found to be permissible in many applications, though this should be confirmed by test for each specific application. Elevated temperature problems are related to creep, but short periods above 63°C may result in acceptable degradation of performance.

5. Humidity

Relative to electret microphones, Knowles has a 1000 hour temperature/humidity test as detailed below. The requirement for the microphones is that no units will be inoperative following the test and recovery cycle.

Accelerated Damp Heat Test Cycle

	Pre-Conditioning
Time	16 Hours
Temperature	$22^{\circ} \pm 1^{\circ}\text{C}$
Humidity	60% max. R.H.
	Test
Time	1000 Hours
Temperature	$63^{\circ}\text{C} \pm 1^{\circ}\text{C}$
Humidity	95% R.H. $\pm 2\%$
	Recovery
Time	2 Hours
Temperature	$22^{\circ} \pm 1^{\circ}\text{C}$
Humidity	60% max. R.H.

During the test cycle of 1000 hours, a voltage stress of 6 Vdc is applied to the positive terminal with respect to the negative terminal and 1.5 Vdc, is applied to the output terminal with respect to the negative terminal to accelerate any ionic corrosion present.

Microphone sensitivity can change with variations in temperature and humidity, but the effect is reversible.

There is little effect on receivers' performance from humidity in normal conditions. However, they could fail if corrosion also takes place when constantly in humid conditions.

Condensation within units should be avoided at all times.

6. Radiation

Nuclear radiation and intense electromagnetic radiation can cause partial or total discharge of electret microphones and, consequently, reduction or total loss of output.

7. Pressure

Normal atmospheric pressure changes will not damage Knowles transducers since a pressure equalization mechanism is provided in each Knowles transducer.

It should be noted however that specifications are at normal atmospheric pressure, and the transducers' sensitivities and response curves will alter with barometric pressure, though these variations are significant only with large changes of pressure (e.g. during changes from sea level to high altitude).

CAUTION: USERS OF KNOWLES RECEIVERS IN HEARING INSTRUMENTS AND IN OTHER PRODUCTS ARE ADVISED THAT THESE RECEIVERS HAVE THE CAPACITY TO PRODUCE VERY HIGH LEVELS OF SOUND PRESSURE. TO AVOID POSSIBLE HEARING DAMAGE, SPECIAL CARE SHOULD BE EXERCISED IN THE APPLICATION OF THESE RECEIVERS.